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Preliminary Evaluation of Resource Recovery Opportunities for Colbert and Lauderdale Counties, Alabama

CSI Resource Systems, Inc.
Boston, MA

Prepared for

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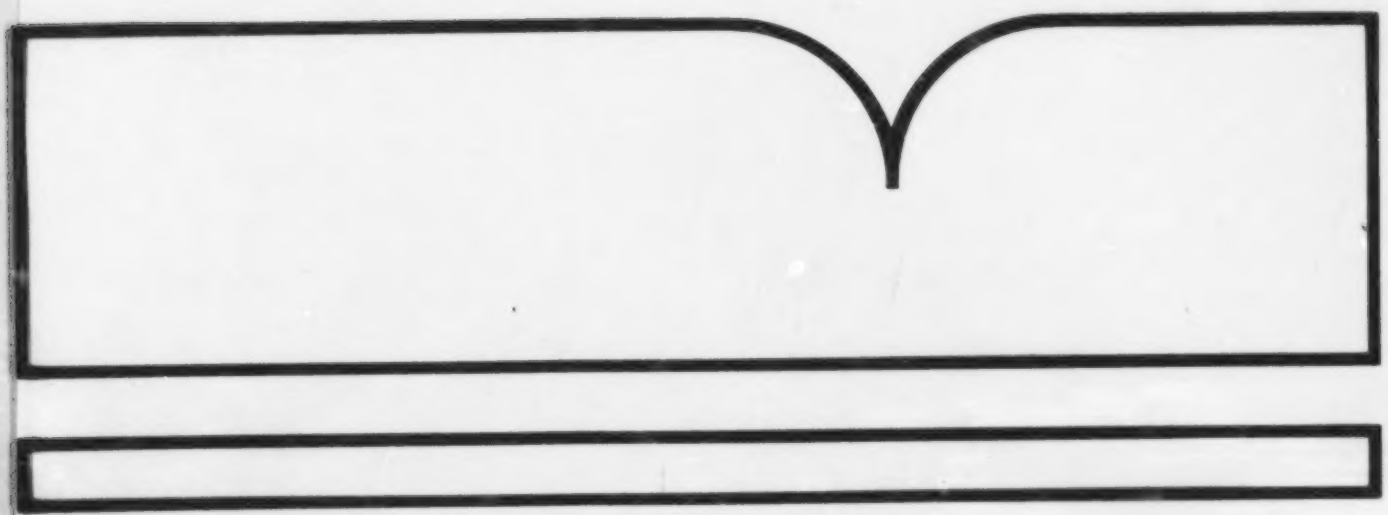

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Preliminary Evaluation of Resource Recovery Opportunities for Colbert and Lauderdale Counties, Alabama

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RESOURCE RECOVERY AND CONSERVATION PANELS

SEC. 2003. The Administrator shall provide teams of personnel, including Federal, State, and local employees or contractors (hereinafter referred to as "Resource Conservation and Recovery Panels") to provide States and local governments upon request with technical assistance on solid waste management, resource recovery, and resource conservation. Such teams shall include technical, marketing, financial, and institutional specialists, and the services of such teams shall be provided without charge to States or local governments.

This report has been reviewed by the Project Officer, EPA, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Project Officer: Elmer G. Cleveland

PRELIMINARY EVALUATION
OF RESOURCE RECOVERY OPPORTUNITIES
FOR COLBERT AND LAUDERDALE COUNTIES, ALABAMA

Prepared for

OFFICE OF SOLID WASTE MANAGEMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY

by

CSI RESOURCE SYSTEMS, INC.

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This study included two visits to Colbert and Lauderdale Counties as well as interviews with county, municipal, and industrial personnel. The study found that both counties face solid waste disposal problems; new waste disposal capacity is needed; citizens oppose new landfills; and per ton disposal costs are increasing rapidly. Resource recovery alternatives, however, are feasible for both counties. Preliminary findings are outlined in this report.

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PREFACE

This report was prepared for Colbert and Lauderdale counties, Alabama, under the Technical Assistance and Panels Program, which is conducted by the U.S. Environmental Protection Agency (EPA) to provide assistance to state and local governments. Technical assistance was provided in response to requests submitted to U.S. EPA Region IV by The Northwest Alabama Council of Local Governments on behalf of Colbert and Lauderdale counties.

The report presents the results of a preliminary determination of the feasibility of resource recovery for the two counties. This determination involved evaluation of the market potential for energy recovery; assessment of energy recovery's potential as an industrial development catalyst; development and evaluation of existing current and future resource recovery alternatives; and identification of the major tasks to be performed prior to deciding to implement a resource recovery project. These activities reflect the results of two site visits to Colbert and Lauderdale counties by CSI Resource Systems, Inc., and interviews with personnel from the two counties; various municipalities located in the two counties; and three industrial energy users in the area.

Resource Systems is a technical assistance contractor to the Office of Solid and Hazardous Waste, U.S. EPA Region IV. Under the terms of the Technical Assistance and Panels Program, all of Resource Systems' technical assistance activities on behalf of Colbert and Lauderdale counties were paid for by EPA.

Resource Systems wishes to thank especially Richard Holst of the Northwest Alabama Council of Local Governments and Hollie Allen, Florence City Commissioner, for their support and generous cooperation.

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CHAPTER 1. OVERVIEW

The Northwestern Alabama area expects to face solid waste management problems in the next 5 years, because the capacities of landfills in the area are limited and waste disposal costs are rising. Particular concern has been expressed by Colbert and Lauderdale counties. The Colbert county landfill has an estimated remaining life of only 2 years; two of the three landfills serving Lauderdale county have a remaining useful life of only 2 years and the third has just 3 years remaining capacity. In response to these problems, a preliminary study was undertaken to determine whether resource recovery could realistically be considered as an alternative approach to solid waste management in the two-county area.

A March 1981 study performed by the Division of Energy Demonstration and Technology of the Tennessee Valley Authority (TVA) addressed the feasibility of resource recovery for the Colbert Lauderdale area. Entitled Potential for Resource Recovery from Municipal Solid Waste in Colbert and Lauderdale Counties, Alabama, this report indicated that resource recovery may be effective in keeping future disposal costs down.

Because the results of th.. broad, preliminary study were encouraging, Colbert and Lauderdale counties requested technical assistance from the U.S. Environmental Protection Agency (EPA), under its Technical Assistance and Panels Program. The purpose of this assistance was to evaluate the findings of the previous report and to identify specific, feasible resource recovery alternatives.

Underlying their interest in determining the feasibility of energy recovery is the two counties' recognition that solid waste is a valuable alternative energy resource.

Colbert and Lauderdale counties together generate an estimated 80,800 tons of solid waste annually. Typical higher heating value (HHV) estimates of 4,500 British thermal units (Btu) per pound suggest that a ton of solid waste has an energy value equivalent to nearly 62 gallons, or 1.4 barrels, of oil. Thus, the solid waste currently discarded by the two counties each year has an energy equivalent of over 113,000 barrels of oil. Rapid increases in energy prices have provided an additional impetus to recovering this energy from solid waste. In addition, by reducing substantially the volume of material to be landfilled, resource recovery can extend the useful lives of future landfills.

The feasibility of resource recovery in the two counties depends upon the presence of five basic ingredients:

- Potentially viable energy buyers whose requirements would use all of most of the usable, or processible, solid waste generated.*
- A sufficient tonnage of processible solid waste from which enough energy and/or salable materials could be produced to meet the requirements of one or more potentially viable buyers.
- Potentially available sites that are well situated with respect to the shipment of solid waste and the delivery of energy to prospective buyers.
- Resource recovery technologies that can reliably process available solid waste and produce energy and/or salable materials in the form, quality, and quantity required by prospective buyers.

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* Processible solid waste is that tonnage of the total waste potentially available which could be processed in a resource recovery facility. Unprocessible materials include oversized bulky waste (e.g., large metal objects, bed springs, rugs) and white goods.

- A total disposal cost that is competitive with the costs of alternative disposal methods available to participating communities.

To assist the two counties in establishing the feasibility of resource recovery, the solid waste disposal problems faced by the two counties were assessed, including an examination of current waste collection and disposal practices, the quantity of waste generated, and current and projected landfill costs. Next, specific resource recovery alternatives were defined by identifying potential customers for recovered energy and technologies that are compatible with both the customers' energy needs and the available waste. These alternatives include a project which Colbert county could pursue individually, as well as a joint project which could serve both counties. Finally, the alternatives were evaluated, focusing on their total annual disposal costs as compared with the cost of continued landfilling. Projects that appear to be feasible, and the steps to be taken before implementing these projects, were identified.

In the remainder of this chapter, the study findings/conclusions are presented, and the immediate next steps to be taken by the counties are noted, along with general issues of importance to project implementation.

STUDY FINDINGS/CONCLUSIONS

The findings of the preliminary feasibility study indicate that two resource recovery alternatives are feasible: one alternative would accept waste from both counties, the second alternative would serve Colbert county alone. Based on these findings, the two counties should give serious consideration to in-depth exploration of these projects. This conclusion is based upon the following study findings:

- Colbert and Lauderdale counties face

solid waste disposal problems because:

- with annual waste generation of 32,800 and 48,000 tons, respectively, Colbert and Lauderdale counties will need new waste disposal capacity in the near future
- siting new landfill capacity is becoming increasingly difficult because of citizen opposition
- per ton disposal costs now estimated in the $4-6 range are projected to increase rapidly, reflecting land acquisition and development costs, more stringent environmental regulations and inflationary factors.

- Both Colbert and Lauderdale counties appear to have available sufficient processible waste to support their own resource recovery projects.
- There are three potential buyers of low-pressure process steam located in Colbert county; no suitable potential energy customers appear to be located in Lauderdale county.
- A joint project with the National Fertilizer Development Center (NFDC) appears feasible. This project would consist of a modular combustion system (MCS) with a design capacity of 300 tons per day (TPD) and an average throughput of 225 TPD_7.* This MCS would convert the solid waste generated by both Colbert and Lauderdale counties to low-pressure process steam for sale to NFDC. Depending upon the financing method used, this alternative would offer the two counties an estimated per ton disposal cost of $15 to $20 in 1984 and $12 to $19 in 1989.

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* Design capacity is the manufacturer's rated capacity of the waste processing equipment. Annual average throughput is the amount of waste processed by the system on a TPD_5 (5-day-per-week) or TPD_7 (7-day-per-week) basis (depending on the system definition) averaged throughout the year.

- For Colbert county alone, the most attractive resource recovery opportunity is a MCS with a design capacity of 150 TPD with an average throughput of 128 TPD_5. This MCS would convert waste generated in Colbert county to low-pressure process steam for sale to either Robbins Tire and Rubber or the Reynolds Aluminum Listerhill Complex. Depending upon the financing method used, this alternative would offer the county per ton disposal costs ranging from $13.50 to $17.00 in 1984 and $8 to $11.50 in 1989.

- In the absence of a compatible market for resource recovered energy, Lauderdale county alone does not have a feasible resource recovery alternative. However, in the event that Lauderdale county can identify and secure a suitable market through its industrial development efforts, the available waste resources can support a 225 TPD MCS.

- These resource recovery projects compare favorably with continued primary reliance on landfilling in several respects:

  - resource recovery offers decreasing waste disposal costs, which could be competitive with the projected cost of landfilling by 1986

  - a cost-competitive and secure alternative source of energy is provided for energy customers

  - additional jobs are created in the two counties

  - the remaining useful lives of the landfills serving the two-county area will be extended

  - resource recovery is an environmentally sound disposal practice.

NEXT STEPS

The findings outlined above are preliminary indications of project feasibility; further investigation is necessary to determine whether these projects can or should be implemented. Specifically, three major tasks must be performed to verify the preliminary findings, before committing substantial resources to implement a resource recovery project. These next steps are:

1. Ascertain the level of interest of prospective energy customers. Perform more detailed evaluations of their energy practices and requirements, including detailed energy load profiles with hourly, daily, and seasonal variations; aggregate current and projected fuel costs; and electrical, water, and other utility charges.

2. Establish a weighing program in the Colbert and Lauderdale counties to ascertain that sufficient solid waste is available, and perform an analysis of waste composition in both counties to ascertain that the waste has a sufficient energy value to satisfy the requirements of potential energy buyers. In addition, determine the seasonal fluctuations in waste quantity and composition.

3. Determine who controls the various portions of the waste stream and develop strategies to ensure that waste generated in the two-county area can be directed to the designated resource recovery facility.

If these three tasks confirm the potential feasibility of the projects identified, a detailed feasibility study should be performed. Such a study will enable Colbert and Lauderdale counties to decide whether to proceed toward resolving project implementation issues, including system performance requirements, risk management, procurement, and financing.

Colbert and Lauderdale counties should also be aware that:

- More than 25 percent (by weight) of the waste stream will require ultimate landfill disposal, even if resource recovery is implemented. This waste includes oversized, bulky materials and noncombustibles, which are diverted from the project, and residues of combustion. The cost of this landfilling has been taken into account in developing the economic projections.

- The lead time for a resource recovery project is significant. For example, implementation of an MCU system requires a minimum of 24 months after procurement contracts are executed. This lead time suggests mid-1984 as the earliest date for a fully operational system. Should Lauderdale elect to pursue its own project, the identification and acquisition of a suitable energy market will likely entail another 12 to 24 months.

- Until recently, industry viewed recovered energy as lower in quality and less reliable than other types of energy, and expected the price of the recovered energy to be lower. This expectation is beginning to change, as industrial concerns recognize that resource recovery offers them energy self-sufficiency.

In the remainder of this report, the results of the preliminary feasibility study are presented. In Chapter Two, current waste collection and disposal practices are described; the quantity of solid waste generated in the two counties is estimated; and the costs of continued landfilling are projected. In Chapter Three, specific resource recovery alternatives are defined on the basis of potential energy markets identified and technologies selected as appropriate. In Chapter Four, these alternatives are evaluated in terms of their economic competitiveness with landfilling and their overall advantages and disadvantages. In Chapter Five, the

next steps to be taken are described, and more general implementation issues are briefly reviewed. In the Appendix to this report, the concept of utilizing resource recovery as an industrial development catalyst is discussed, a number of industries found to be suitable candidates for resource-recovered energy are identified and possible economics of a Lauderdale County facility providing energy to a newly recruited industry are presented.

CHAPTER 2

SOLID WASTE COLLECTION, DISPOSAL, AND GENERATION

The attractiveness of resource recovery for Colbert and Lauderdale counties depends in part on the extent to which the two counties face solid waste disposal problems, and on the economics of resource recovery as compared with alternative waste disposal methods (i.e., continued primary reliance on landfilling). To identify waste supply disposal problems, current solid waste collection and disposal practices were reviewed, and preliminary estimates of waste generation were developed. Current waste disposal costs were then determined, and the costs of continued landfilling were projected for the years 1984, 1988 and 1989. A comparison of waste generation and the estimated lives of existing landfills indicates that both counties face solid waste disposal problems in the near future. The counties will need additional disposal capacity, and new landfills will likely be difficult to site. Moreover, as cost projections indicate, landfill disposal costs are expected to escalate rapidly.

In this chapter, current solid waste collection and disposal practices in the two counties are described; waste generation is estimated, and the future costs of landfilling are projected.

CURRENT COLLECTION AND DISPOSAL PRACTICES

To assess solid waste disposal problems, current solid waste collection and disposal practices in Colbert and Lauderdale counties were examined. In both these areas, waste is collected predominantly by municipalities and the counties themselves. The waste collected in the two-county area is disposed of in four landfills, each with remaining capacity of only 2 to 3 years. Of these four landfills, only one (which serves the City of Florence in Lauderdale county) has a designated replacement facility.

Colbert County

In Colbert county the incorporate areas of Muscle Shoals, Sheffield and Tuscumbia provide municipal collection services to residential and commercial establishments on a twice-per-week, door-to-door basis. Households located outside these incorporated areas are served by a once-per-week "mailbox"-type collection provided by the county. Industrial entities and large commercial establishments either have their own wastes or utilize private collectors, the largest of which is Waste Contractors.

The Colbert county landfill, located just south of Tuscumbia, is the only disposal facility serving the county. Owned and operated by the county, this landfill has an estimated useful remaining life of 2 years.

Colbert county residential and commercial waste generation is estimated at 443 tons per week by landfill personnel (based on visual observation of vehicle deliveries). Of this total, it is estimated that Colbert county generates 108 tons, Muscle Shoals 99 tons, Sheffield 135 tons, and Tuscumbia 101 tons. Waste Contractors, the major private collection firm in the area, estimates it collects another 188 tons of weekly waste from industrial and commercial accounts throughout the county, a figure representing approximately 42 percent of the county's entire estimated waste volume of 631 tons per week.

Utilizing the above waste generation estimates and county financial records of total disposal costs indicates that 1980 solid waste disposal costs were in the range of $4.00 per ton.

Lauderdale County

In Lauderdale county the cities of Florence and Rogersville provide door-to-door municipal collection (twice per week and once per week, respectively). Households located

in the remainder of the county are served by private collectors franchised by the county; typical service is once per week, door to door. Industries located in Lauderdale county either deliver waste to one of the landfills located in the county or are served by private waste haulers, the largest of which is Waste Contractors (a Waste Management, Inc. affiliate).

There are three operating landfills throughout Lauderdale county - two owned and operated by the county and the third, by the City of Florence. The two county landfills are located in Underwood and Lexington, and have estimated remaining lives of 2 and 3 years, respectively. The Florence landfill has an estimated useful life of 2 years, although the city has secured what it feels is an appropriate site for a new landfill.

Waste generation estimates, again based on visual observations of vehicle deliveries by landfill personnel, indicate that Lauderdale county waste from all sources approximates 923 tons per week. Of this figure, it is assumed that Florence generates 506 tons, Rogersville 36 tons, and the remainder of Lauderdale county 325 tons. Waste Contractors estimates it accounts for another 56 tons, or approximately 6 percent of the above total. Based on these waste generation figures and available landfill cost data, it appears that the 1980 per ton cost of operating the Florence landfill was in the $4.00 range; the 1980 per ton cost of operating the county-owned Underwood and Lexington landfills is estimated at $4.50.

WASTE GENERATION

Colbert and Lauderdale counties generate sufficient solid waste to support their own resource recovery facility or a two-county facility. Estimated waste generation in the

two counties is shown below:

County	Estimated 1980 Waste Generation (tons/year)
Colbert	32,800
Lauderdale	48,000
TOTAL:	80,800

These estimates are based upon visual observation of residential and commercial waste deliveries conducted by landfill personnel at the four landfills serving the two-county area and industrial waste generation estimates provided by the major private waste haulers. Based upon a 1980 estimated two-county population of 133,000, waste generation translates to 3.33 pounds per capita per day. As other rural areas throughout the United States with similar population and industrial base have revealed per capita generation rates ranging from 3 to 4 pounds, these waste generation estimates appear reasonable.

The above estimates of the quantity of waste generated do not reflect seasonal variations in waste generation; nor do they provide for increases in future waste generation as a result of increased per-capita generation rates or population growth. Generation rates are not likely to increase significantly. For the purposes of this feasibility study, seasonal variations and population growth have not been considered; however, if a resource recovery project were to be implemented, the impact of these two factors on waste generation would need to be assessed.

CURRENT AND PROJECTED LANDFILL COSTS

As a basis for determining the economic feasibility of resource recovery, current landfill costs for Colbert and Lauderdale counties were examined, and 1983 and 1989 landfill costs were projected, assuming that a resource recovery

project would not be implemented. These projections take into account site acquisition and development costs and the cost of operating a landfill that meets the minimum standards proposed by EPA under the Resource Conservation and Recovery Act (RCRA).

In Colbert County, 1980 per-ton disposal costs were estimated at $4.00. If Colbert County elected to use continued landfilling as a disposal method, it would have to acquire, develop and operate a new landfill. Assuming that waste generation will remain consistent at 32,800 tons per year, landfill costs are projected at $10.00 per ton in 1983 and about $16.00 per ton in 1989. The derivation of these landfill cost projections are contained in Tables 2.1 through 2.3 which follow.

In Lauderdale County, the 1980 cost of operating the three current disposal facilities ranged from $3.50 to $4.50 per ton. If Lauderdale County continues to dispose of waste in landfills, the County will have to acquire, develop and operate at least one new facility. Assuming that waste generation remains constant and that the County decides to implement only one facility, landfill disposal costs, exclusive of transportation, are projected at $9.50 per ton in 1983 and $15.00 per ton in 1989.

TABLE 2.1

LANDFILL COST ASSUMPTIONS

Two new landfills are developed in 1983; one serving Colbert county, one serving Lauderdale county.

New landfills conform to RCRA guidelines (e.g., have leachate collection and storage).

One ton of waste occupies 2 cubic years in the landfill.

Average depth of fill equals 45 feet.

One cubic yard of cover material (at a cost of $1 per cubic yard) is needed for every 3 tons of waste.

No transportation costs are included in projections.

A steel-wheeled compactor, a front-end loader, and a scale are needed to operate the landfill. The useful life of the compactor and loader is 6 years; the life of the scale and any other equipment or buildings is 10 years.

Three people are needed to operate the landfill.

Operating costs increase at 10 percent per year; construction costs, at 10 percent per year.

RCA regulations add 25 percent to operating cost of Colbert landfill; 15 percent to operating cost of Lauderdale landfill.

TABLE 2.2

COST OF NEW LANDFILL DEVELOPMENT

CAPITAL COST, 1983 ($/acre)

1981 Costs

Grading and liner	$ 22,000
Leachate collection and storage system	16,500
Geotechnical exploration, engineering, and wells	5,500
Subtotal	$ 44,000
Development costs and contingencies (@ 20%)	8,800
Cost of Land	3,000
TOTAL	$ 55,800

1983 Costs

$55,800/ton x $(1.10)^3$	$ 74,300
Interest cost (10 yrs @ 10%)	46,620
TOTAL	$120,920/acre

TONS PER ACRE

Assuming fill depth of 45 feet, landfill capacity is 45 acre-feet per acre. At 800 tons per acre-foot, landfill capacity is 36,000 tons per acre.

CAPITAL COST, 1983 ($/ton)

120,920/acre ÷ 36,000 tons/acre = $3.36/ton.

TABLE 2.3

PROJECTED LANDFILL COSTS ($/year)

	Colbert County (32,800 tons)	Lauderdale County (48,000 tons)
1983 Costs (per ton)		
Operating costs	$ 6.65	$ 6.12
Landfill development costs	3.36	3.36
TOTAL	$ 10.01	$ 9.48
1989 Costs (per ton)		
Operating costs (1983 operating costs x 1.95)	$ 12.97	$ 11.93
Landfill development costs ($3/ton)	3.36	3.36
TOTAL	$ 16.33	$ 15.29

CHAPTER 3. RESOURCE RECOVERY ALTERNATIVES

To investigate the potential role of resource recovery in solid waste management for Colbert and Lauderdale Counties, an energy market survey was conducted and two technically feasible resource recovery alternatives were identified. Each of these alternatives is based on a proven resource recovery technology that can use the available waste supply to produce usable energy in a form and quantity that fit the needs of potential energy buyers.

The estimate of the quantity of waste available to a resource recovery facility is based on current waste generation projections, it was assumed, in the absence of a waste sampling program, that recovered materials (e.g., corrugated, white goods) and unprocessible waste amount to two percent of total waste generation. The remaining 98 percent of waste is assumed to be processible, on the basis of visual inspection of waste by local officials and previous experience. The resulting estimates of available waste supply are shown in the following table:

	Estimated Processible Waste Available		
County	TPD_5	TPD_7	Tons per Year
Colbert	124	89	32,140
Lauderdale	181	131	47,040
TOTAL	305	220	79,180

Given these estimates of available waste supply, technically feasible resource recovery alternatives for the two counties were defined by:

- Identifying potential markets for the energy that could be produced from the available waste
- Selecting resource recovery technologies that are compatible with the requirements of the markets and the characteristics of the available waste.

In addition to the two feasible alternatives previously mentioned, a possible third project was identified which would meet the disposal needs of Lauderdale County provided a suitable energy customer could be secured through the County's ongoing industrial development activities. A discussion on the potential of resource recovery as an industrial development catalyst and projected economics for a Lauderdale County project (assuming a suitable energy market can be secured) is contained in Appendix.

POTENTIAL ENERGY MARKETS

The previously completed TVA study entitled Potential for Resource Recovery from Municipal Solid Waste in Colbert and Lauderdale Counties, Alabama identified three potential energy markets for waste derived energy. Based on the results of the study follow-up, interviews were held with representatives of the National Fertilizer Development Center in Muscle Shoals, the Reynolds Aluminum Listerhill Complex in Muscle Shoals, and the Robbins Tire and Rubber Company in Tuscumbia to verify their suitability as potential energy customers.

These three entities were identified as compatible customers for resource recovered energy based in the following characteristics.

Interest in Resource Recovery. Although interest cannot be viewed as a commitment, it was considered a prerequisite for a potential customer.

Technical Capability to Use Recovered Energy. Each of the three potential customers currently uses low-pressure steam which can be recovered from solid waste, for process requirements and/or heating and cooling. Average hourly energy loads are high, seasonal variations in energy use appear to be acceptably low, and there are no unusual pressure or temperature requirements.

Continuity of Operations. Each of the three potential customers operates three shifts, 5, 6, or 7 days per week, indicating potentially high capacity utilization.

Current Use of High-cost Fuel. Each potential customer currently uses natural gas, a high-cost fuel. In these three markets, recovered energy would displace steam or high-temperature gas, generated from natural gas at a cost of $3.30 to $5.00 per million Btu. From previous experience, $2.30 per million Btu was considered the minimum current steam cost that would make resource recovery economically feasible.

Proximity to a Suitable Site. At least one vacant site of adequate size is located close enough to each of the three potential energy markets to enable economic transportation of steam or high-temperature gas.

Proximity to Waste Source. Robbins Tire and the Reynolds Aluminum Complex are close enough to the source of waste so that waste transfer operations are not necessary assuming a single county project. As the NFDC is capable of utilizing the solid waste from both Colbert and Lauderdale counties, a resource recovery facility serving this market would likely require a transfer station to accommodate Lauderdale county waste. (As the waste transported from Lauderdale county, which represents about 60 percent of the available two-county waste, must travel via a single bridge which connects the two counties, some concerns have been expressed relative to traffic impacts upon the bridge and neighborhoods contiguous to this bridge.)

Stability. Each potential energy customer has been operating in the area for at least several years and appears to be in sufficient financial health to justify consideration as a long-term energy buyer.

The following table presents the fuel usage and energy requirements of the three potential customers for resource recovered energy:

POTENTIAL ENERGY MARKETS

Potential Energy Market	Energy Requirement		Fuel Displaced
	Form	Per Hour	
National Fertilizer Development Center Colbert County (Muscle Shoals)	Steam	64,000 average 36,000 minimum 92,000 maximum	Natural Gas
Reynolds Aluminum Listerhill Complex Colbert County (Muscle Shoals)	Steam	51,000 average 58,000 maximum	Natural Gas
Robbins Tire & Rubber Colbert County (Tuscumbia)	Steam	33,000 average 58,000 maximum	Natural Gas

TECHNICALLY FEASIBLE ALTERNATIVES

The estimated quantity of combustible solid waste available and the energy requirements of prospective customers dictage both the scale of a resource recovery facility and the form of energy produced. To identify resource recovery alternatives, the energy requirements of the three potential energy customers were compared with the technical characteristics of compatible, demonstrated technologies. As a result, the following two resource recovery alternatives were defined:

1. A 300 TPD modular combustion system utilizing waste from Colbert and Lauderdale counties to provide steam to NFDC.

2. A 150 TPD modular combustion system utilizing waste from Colbert county to provide steam to NFDC, Reynolds Aluminum or Robbins Tire.

These alternatives are summarized in Table 3.1.

The modest quantity of solid waste generated by Colbert and Lauderdale counties and the low-pressure steam requirements of each potential customer for waste derived energy indicates that a modular combustion system (MCS) is likely to be the most appropriate technology option available for either or both counties.

Steam markets with low demand (20,000-80,000 pounds of steam per hour) and, thus, small processing requirements for solid waste (100-400 TPD), can be served by MCSs, which are pre-engineered, factory-assembled systems. MCSs equipped for solid waste processing, energy recovery, and continuous ash removal are available in the individual unit sizes ranging from 10 to 75 TPD.

Figure 3.1 provides a simplified diagram of an MCS which is typical of many of the designs offered. As shown in this figure, waste is delivered to the resource recovery facility, onto a concrete loading floor. Unprocessible materials (e.g., large metal objects, water heaters, rugs) are removed and placed in residue containers for sale as scrap or for disposal in a landfill. A front-end loader is used to push the remaining solid waste into a hopper, and a hydraulic ram-feeder moves the waste into the incinerator's lower chamber where it is partially burned. The heat released provides the energy needed to dry and gasify the remaining waste. The carbon-monoxide-rich smoke leaves the top of the lower chamber and enters the secondary chamber; there, more air is added, and the gases are burned to completion. As the hot gases exit the secondary chamber, they pass through a heat exchanger, where the heat in the exit gases is converted to steam. The stack gases are then discharged to the atmosphere.

Ash consisting of glass, stone, metals, inert solid waste, and uncombusted organics is moved from the bottom of the lower chamber into an ash quenching and disposal system. A magnet

TABLE 3.1

RESOURCE RECOVERY ALTERNATIVES

ALTER-NATIVE	WASTE SOURCE	ENERGY MARKET	SYSTEM CONFIGURATION	SYSTEM CAPACITY			ENERGY PRODUCT	
				Throughput TPD	Days/ Week	Design Capacity TPD	Form	Quantity/ Hour
1	Colbert/ Lauderdale	NFDC	4 75-TPD Modules	224	7	300	Steam	42,000 lb.
2	Colbert	NFDC, Robbins or Reynolds	2 75-TPD Modules	129	5	150	Steam	24,200 lb.

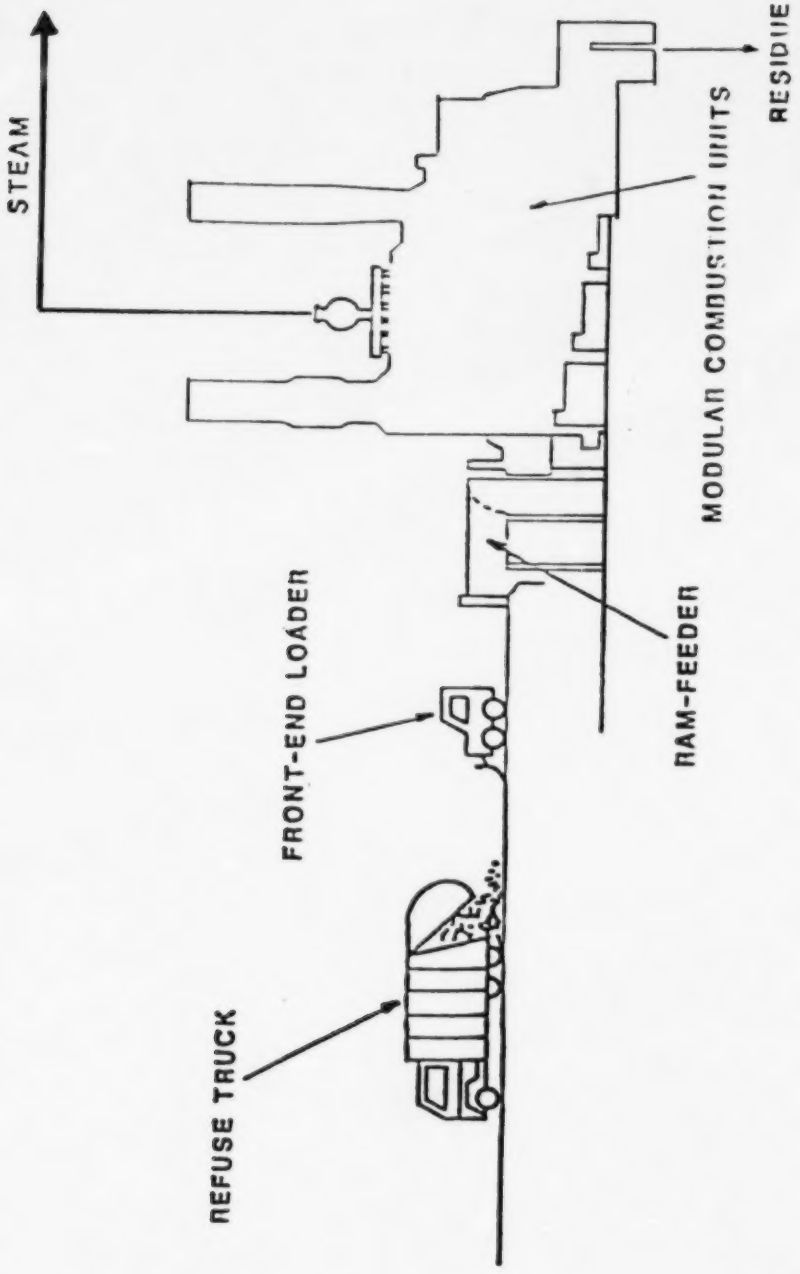

Figure 3.1 Modular Combustion Unit

that recovers magnetic metals for sale to the secondary metal market can be installed. The remaining ash is loaded into a truck for disposal at a landfill.

Alternative 1. 300-TPD MCS Providing Steam to NFDC

The first alternative (Alternative 1) would use the waste streams from both Colbert and Lauderdale counties to supply low-pressure steam to the NFDC in Muscle Shoals. A transfer station would be located in Lauderdale county from which tractor-trailer trucks could haul county waste to the facility. A 300-TPD MCS comprised of 75-TPD modules would operate 7 days per week processing an average 224 TPD_7. A new landfill would be located in Colbert county to be used as a disposal site for plant residues and wastes that must bypass the plant.

In defining the system, the following technical assumptions were used:

- The higher heating value of the combined wastes from Colbert and Lauderdale counties is 4,500 Btu per pound.
- System thermal efficiency is 60 percent.
- System configuration is four 75-TPD modular combustion units; each unit has a 90 percent availability, including scheduled maintenance.
- Steam is raised at 150 psig, 350^{o}F.
- Steam output is approximately 4,500 pounds per ton of waste with no condensate return.
- System operation is 24 hours per day, 350 days per year.
- Average waste throughput is 224 TPD_7, or 78,400 tons per year.
- Residuals to landfill are 21,200 tons per year.

Alternative 2. 150-TPD MCS Providing Steam to Robbins Tire and Rubber or Reynolds Aluminum

The second alternative (Alternative 2) would use Colbert county waste to produce low-pressure steam for either Robbins Tire and Rubber in Tuscumbia or Reynolds Aluminum Listerhill complex in Muscle Shoals. Waste collected in the county would be delivered to a facility with a design capacity of 150 TPD. The facility would be comprised of two 750-TPD modules, operate 5 days per week, and process an average 129 tons of solid waste daily. A new landfill would be located in Colbert county to accommodate plant residues and by-passed wastes.

In defining this system, the following technical assumptions were used:

- The higher heating value of Colbert county waste is 4,500 Btu per pound.
- System thermal efficiency is 60 percent.
- System configuration is two 75-TPD modular combustion units; each unit has a 90 percent availability, including scheduled maintenance.
- Steam is raised at 150 psig, 350^{o}F.
- Steam output is approximately 4,500 pounds per ton of solid waste with no condensate return.
- System operation is 24 hours per day, 250 days per year.
- Average waste throughput is 129 TPD_5, or 32,100 tons per year.
- Residuals to landfill are 8,692 tons per year.

CHAPTER 4. PRELIMINARY ECONOMIC ASSESSMENT

The economic feasibility of a resource recovery project may be determined by comparing the projected cost of that option with that of alternative disposal methods. For both Colbert and Lauderdale counties, the preferred alternative to resource recovery appears to be the implementation and operation of one or more new landfill disposal facilities.

A preliminary economic assessment was conducted for the two resource recovery system alternatives described in the previous section to allow a comparison of the economics of resource recovery with those of continued primary dependence on landfilling.

In conducting the preliminary economic analysis, it was found that the bond issue requirements, and, hence, the cost of a resource recovery system vary significantly, depending on the financing method used. To take these variations into account, cost projections were developed under three different financing methods: 100-percent Industrial Revenue Bond (IRB) financing, 100-percent General Obligation Bond (GO) financing, and 75-percent IRB/25-percent Equity financing.

To date, IRBs have been the principal instrument used for financing resource recovery projects. However, because of the tax benefits it affords to the investor, equity investment in a resource recovery project is becoming more common and was therefore included in the comparative economic analysis.

Alternative 1, a regional facility providing disposal service to both counties, projects a 1984 per ton net disposal cost of $15 to $20 and a 1989 net disposal cost ranging from $12 to $19, depending upon financing method employed.

Alternative 2, a facility meeting the disposal requirements of Colbert county alone, projects a 1984 per ton disposal

cost of $13.50 to $17.00 and a 1989 disposal cost of $8 to $11.50, depending upon financing method used. Under the most favorable financing option this alternative also becomes competitive with Colbert county's projected costs of continued landfilling by 1986.

The remainder of this section summarizes the methodology and the assumptions used, as well as the findings and conclusions.

METHODOLOGY

To be considered economically feasibly, a resource recovery project should offer the participating counties a net solid waste disposal cost that is competitive with the cost of continued primary reliance on landfilling. The net solid waste disposal cost is determined by subtracting project energy revenues from the capital and operating and maintenance costs associated with the resource recovery facility and the capital and operating and maintenance costs of a backup landfill for residues, unprocessibles, and wastes that must bypass the facility.

To determine the economic feasibility of the two alternatives, the net disposal cost of each alternative was projected for 1984 and 1989, the assumed first and sixth years of facility operation. The year 1984 was selected as the first year of facility operation to reflect the lead time for design, construction, and startup of the resource recovery facility. Although life-cycle costing would have been an appropriate method of economic evaluation, the difficulty of projecting costs and revenues over the life of a facility (more than 20 years) limited the projections to 1989.

The assumptions used in developing the economic projections and the derivation of the major elements of the cost projections are summarized below.

Projected System Costs

The 1981 capital costs of each option evaluated were developed from engineering estimates and recent bids submitted by full-service vendors for comparably sized resource recovery systems; these costs were then projected to 1983 (assumed to be the midpoint of construction) at an annual compounded rate of 10 percent for all three financing approaches. For both IRB and IRB/equity financing methods, energy and disposal fee revenues are the only source of payment for bondholders, who receive tax-exempt interest at a rate assumed to be 12 percent. Under the GO financing alternatives, bondholders are guaranteed a return based on both project revenues and the "full faith and credit" of the issuing entity. As a result, the risk to bondholders is significantly reduced, hence a lower return is warranted. In this case, a tax-exempt return of 11 percent is assumed. For IRB/equity financing, the 25-percent equity contribution enables reductions in the debt service reserve and capitalized interest accounts and reduces the total bond issue by approximately $1.45 for each dollar of equity invested.

Projected Energy Revenues

In projecting the energy revenues for each alternative evaluated, the following assumptions were made:

- The resource recovery facility becomes operational in 1984.
- Costs, including capital and operating and maintenance, escalate at an annual rate of 10 percent per year.
- Financing terms are: 17 years at 12 percent interest for IRB and IRB/equity financing approaches; 17 years and 11 percent for GO financing.
- Steam energy revenues are predicated upon the fuel (natural gas) value of 150 psig steam at an assumed boiler

efficiency of 85 percent with no condensate return. Natural gas is assumed to be deregulated by 1984 and priced at parity with No. 6 fuel oil. Annual escalation in fuel prices is 10 percent, hence steam revenues increase at the same price.

Projected Backup Landfill Costs

To fully reflect the costs of disposal under resource recovery, consideration has to be given to the ultimate disposal of unprocessible wastes, bypassed wastes, and residuals from combustion. For purposes of this preliminary analysis, it was assumed that the average per-ton cost of landfilling this volume of waste in an environmentally complying disposal facility would be $12.00 in 1984, with a 10-percent annual escalation.

It was assumed that unprocessibles and bypassed waste amount to 5 percent of the total waste available, and residuals represent 25 percent of the input tonnage.

Projected Costs of Continued Primary Reliance on Landfilling

In Chapter Two, the projected costs of continued landfilling were developed for both counties over the period 1983 to 1989. These projections reflect the estimated cost of acquiring and developing new disposal sites; operating and maintaining the sites in a manner consistent with more rigorous requirements of RCRA, as well as inflationary impacts. For Colbert county, 1983 per ton disposal costs are estimated at $10.00; 1989 costs are projected at approximately $16.30 per ton. For Lauderdale county, the 1983 and 1989 per ton disposal costs under continued landfilling are projected at $9.50 and $15.30, respectively.

FINDINGS/CONCLUSIONS

The following table presents the projected 1984 and 1989

net disposal costs under continued landfilling and for the two resource recovery alternatives evaluated.

OPTION	FINANCING METHOD	1984 COST ($/ton)	1989 COST ($/ton)
Colbert County Landfill	-	10.68	16.33
Lauderdale County Landfill	-	10.09	15.29
Colbert/Lauderdale County Resource Recovery Project (Alternative 1)	IRB	21.99	19.04
	GO	18.61	15.67
	IRB/25% Equity	15.25	12.31
Colbert County Resource Recovery Project (Alternative 2)	IRB	21.14	15.41
	GO	17.17	11.44
	IRB/25% Equity	13.45	7.72

Tables 4.1 and 4.2 present the estimated financing requirements for the two resource recovery alternatives evaluated. Tables 4.3 through 4.8 present the projected 1983 and 1989 economics of both resource recovery alternatives under each of three financing alternatives.

TABLE 4.1

FINANCING REQUIREMENTS FOR ALTERNATIVE #1

REGIONAL 300 TPD MCS PRODUCING

PROCESS STEAM FOR NFDC*

COST ELEMENTS	FINANCING METHOD ($000s)		
	IRB	GO	25% Equity/IRB
A. Capital Cost	11,600	11,600	11,600
B. Engineering/Legal	400	400	400
Less: Equity Contribution	-	-	(3,000)
SUBTOTAL	12,000	12,000	9,000
C. Capitalized Interest	2,182	1,478	1,527
D. Allowance for Startup	400	400	400
E. Debt Service Reserve	2,470	-	1,850
F. Bond Financing	528	139	395
TOTAL BOND ISSUE	17,580	14,017	13,172
TOTAL FINANCING REQUIREMENTS	17,580	14,017	16,132

* Costs are projected to 1983 $ as 1983 would be the beginning of the desing/construction phase; hence, the bond would be issued in 1983.

TABLE 4.2

FINANCING REQUIREMENTS FOR ALTERNATIVE #2

COLBERT COUNTY 150 TPD MCS PRODUCING

PROCESS STEAM FOR ROBBINS TIRE & RUBBER OR

REYNOLDS ALUMINUM COMPLEX*

COST ELEMENTS	FINANCING METHOD ($000s)		
	IRB	GO	25% EQUITY/IRB
A. Capital Cost	5,000	5,000	5,000
B. Engineering/Legal	400	400	400
Less: Equity Contribution	-	-	(1,350)
SUBTOTAL	5,400	5,400	4,050
C. Capitalized Interest	1,110	748	765
D. Allowance for Startup	225	225	225
E. Debt Service Reserve	1,140	-	853
F. Bond Financing	244	65	182
TOTAL BOND ISSUE	8,119	6,438	6,075
TOTAL FINANCING	8,119	6,438	7,425

* Costs are projected to 1983 $ as 1983 would be the beginning of the design/construction phase; hence, the bond would be issued in 1983.

TABLE 4.3

PROJECTED ECONOMICS FOR ALTERNATIVE #1
300 TPD MODULAR COMBUSTION SYSTEM
(IRB FINANCING)

ANNUAL SOLID WASTE THROUGHPUT (tons)	79,200
ANNUAL ENERGY SALES (pounds of steam)	356,300,000

EXPENSE ITEM ($/ton)	OPERATING YEAR	
	1 (1984)	6 (1989)
Debt Service	31.19	31.19
O&M	17.00	27.37
Residual Disposal	3.00	4.83
Operator's Fee	4.00	6.44
Transportation	3.56	5.74
SUBTOTAL	58.75	75.57
REVENUES ($/ton)		
Steam	32.40	52.16
Debt Service Reserve Earnings	4.37	4.37
SUBTOTAL	36.77	56.53
REQUIRED TIP FEE ($/ton)	21.99	19.04

TABLE 4.4

PROJECTED ECONOMICS FOR ALTERNATIVE #1
300 TPD MODULAR COMBUSTION SYSTEM
(GO FINANCING)

ANNUAL SOLID WASTE THROUGHPUT (tons)	79,200
ANNUAL ENERGY SALES (pounds of steam)	356,300,000

EXPENSE ITEM ($/ton)	OPERATING YEAR	
	1 (1984)	6 (1989)
Debt Service	23.45	23.45
O&M	17.00	27.37
Residual Disposal	3.00	4.83
Operator's Fee	4.00	6.44
Transportation	3.56	5.74
SUBTOTAL	51.01	67.83
REVENUES ($/ton)		
Steam	32.40	52.16
Debt Service Reserve Earnings	-	-
SUBTOTAL	32.40	52.16
REQUIRED TIP FEE ($/ton)	18.61	15.67

TABLE 4.5

PROJECTED ECONOMICS FOR ALTERNATIVE #1
300 TPD MODULAR COMBUSTION SYSTEM.
(75% IRB/25% EQUITY FINANCING)

ANNUAL SOLID WASTE THROUGHPUT (tons)	79,200
ANNUAL ENERGY SALES (pounds of steam)	356,300,000

EXPENSE ITEM ($/ton)	OPERATING YEAR	
	1 (1984)	6 (1989)
Debt Service	23.36	23.36
O&M	17.00	27.37
Residual Disposal	3.00	4.83
Operator's Fee	4.00	6.44
Transportation	3.56	5.74
SUBTOTAL	50.92	67.74
REVENUES ($/ton)		
Steam	32.40	52.16
Debt Service Reserve Earnings	3.27	3.27
SUBTOTAL	35.67	55.43
REQUIRED TIP FEE ($/ton)	15.25	12.31

TABLE 4.6

PROJECTED ECONOMICS FOR ALTERNATIVE #2
150 TPD MODULAR COMBUSTION SYSTEM
(IRB FINANCING)

ANNUAL SOLID WASTE THROUGHPUT (tons)	32,100
ANNUAL ENERGY SALES (pounds of steam)	144,648,000

EXPENSE ITEM ($/ton)	OPERATING YEAR 1 (1984)	6 (1989)
Debt Service	35.51	35.51
O&M	15.00	24.15
Residual Disposal	3.00	4.83
Operator's Fee	5.00	8.05
Transportation	-	-
SUBTOTAL	58.51	72.54
REVENUES ($/ton)		
Steam	32.40	52.16
Debt Service Reserve Earnings	4.97	4.97
SUBTOTAL	37.37	57.13
REQUIRED TIP FEE ($/ton)	21.14	15.41

TABLE 4.7

PROJECTED ECONOMICS FOR ALTERNATIVE #2
150 TPD MODULAR COMBUSTION SYSTEM
(GO FINANCING)

ANNUAL SOLID WASTE THROUGHPUT (tons)	32,100
ANNUAL ENERGY SALES (pounds of steam)	144,648,000

EXPENSE ITEM ($/ton)	OPERATING YEAR	
	1 (1984)	6 (1989)
Debt Service	26.57	24.57
O&M	15.00	24.15
Residual Disposal	3.00	4.83
Operator's Fee	5.00	8.05
Transportation	-	-
SUBTOTAL	49.57	63.60
REVENUES ($/ton)		
Steam	32.40	52.16
Debt Service Reserve Earnings	-	-
SUBTOTAL	32.40	52.16
REQUIRED TIP FEE ($/ton)	17.17	11.44

TABLE 4.7

PROJECTED ECONOMICS FOR ALTERNATIVE #2
150 TPD MODULAR COMBUSTION SYSTEM
(GO FINANCING)

ANNUAL SOLID WASTE THROUGHPUT (tons)	32,100
ANNUAL ENERGY SALES (pounds of steam)	144,648,000

EXPENSE ITEM ($/ton)	OPERATING YEAR	
	1 (1984)	6 (1989)
Debt Service	26.57	24.57
O&M	15.00	24.15
Residual Disposal	3.00	4.83
Operator's Fee	5.00	8.05
Transportation	-	-
SUBTOTAL	49.57	63.60
REVENUES ($/ton)		
Steam	32.40	52.16
Debt Service Reserve Earnings	-	-
SUBTOTAL	32.40	52.16
REQUIRED TIP FEE ($/ton)	17.17	11.44

TABLE 4.8

PROJECTED ECONOMICS FOR ALTERNATIVE #2
150 TPD MODULAR COMBUSTION SYSTEM
(25% EQUITY/IRB FINANCING)

ANNUAL SOLID WASTE THROUGHPUT (tons)	32,100
ANNUAL ENERGY SALES (pounds of steam)	144,648,000

EXPENSE ITEM ($/ton)	OPERATING YEAR 1 (1984)	6 (1989)
Debt Service	26.57	26.57
O&M	15.00	24.15
Residual Disposal	3.00	4.83
Operator's Fee	5.00	8.05
Transportation	-	-
SUBTOTAL	49.57	63.60
REVENUES ($/ton)		
Steam	32.40	52.16
Debt Service Reserve Earnings	3.72	3.72
SUBTOTAL	36.12	55.88
REQUIRED TIP FEE ($/ton)	13.45	7.72

CHAPTER 5. STEPS TOWARD IMPLEMENTATION

The results of this preliminary feasibility study of resource recovery for Colbert and Lauderdale counties indicate that the necessary ingredients exist for two resource recovery projects--one project serving both counties, the second limited to Colbert County. However, the technical evaluation and economic analysis of resource recovery alternatives are preliminary, and a number of tasks must be performed and issues resolved before any commitment to implement one or more of the systems is made. Specifically, before committing substantial additional resources to a project, the two counties must determine more precisely: the level of interest of potential energy markets; the quantity of processible waste available, its energy content, and seasonal fluctuations in quantity and quality; and current control of the waste streams. After these determinations have been made, the counties will be able to make informed decisions about implementing specific projects. If both counties decide to implement the joint project or if Colbert elects to implement a single County project, it will be necessary to resolve a number of issues (e.g., sponsorship, risk allocation, procurement financing, optimal system design, legal and institutional problems) before moving ahead with implementation.

In this chapter, the immediate next steps to be taken are outlined, and the remaining issues are discussed.

IMMEDIATE NEXT STEPS

Before a final decision is made to implement a resource recovery project, three tasks must be performed. Each is discussed in the following subsections.

Determine Level of Commitment of Energy Customers

The preliminary market study indicates that three prospective customers are interested in purchasing energy from a resource recovery project; however, this interest is preliminary. For that reason, the level of commitment of potential energy customers must be established to ensure that there will be an energy buyer if the project proceeds. Before deciding to commit themselves to implementation of any project, the two counties must meet with the prospective customers to discuss in detail the customer's energy requirements, their willingness to commit to long-term contracts for the purchase of recovered energy, and their interest in equity participation in a project.

Determine Quantity and Energy Content of Available Waste

The quantity of waste available in Colbert and Lauderdale Counties has not been determined; as a result, considerable additional work is needed in this area. Specifically, a weighing program should be established at each landfill to determine the quantity of solid waste generated in both counties. In addition, waste sampling programs should be conducted in both counties to estimate what portion of total waste generation is processible and the energy content (i.e., HHV) of the processible waste. Finally, the seasonal fluctuations in waste quantity and quality should be established.

Develop Strategies for Waste Control

Although solid waste collection and disposal practices in the two counties have been reviewed, a more detailed analysis of collection and disposal is needed. From this analysis, it should be possible to determine the extent to which the two counties have the right to decide where waste is to be disposed and, thus, to assess the risk that a resource recovery project would not receive all of the waste expected. The counties can then develop appropriate waste control strategies, to ensure

that processible waste will be directed to the resource recovery facility. This is particularly important in Colbert County, where it appears that nearly 42 percent of the waste is collected by private waste haulers.

IMPLEMENTATION ISSUES

If the results of the steps detailed above confirm the preliminary feasibility of resource recovery and a decision is made to implement one or more projects, a number of issues will need to be addressed prior to implementation. Many of these issues are interrelated and cannot be considered totally independently. Therefore, to resolve these issues, it will be necessary to address several of them simultaneously, rather than consecutively. The issues include:

- Who will sponsor the project?
- How should project risks be allocated?
- What procurement method should be used?
- What financing method is most appropriate?
- What is the optimal system design?
- What are the legal and institutional barriers to implementation, and how can they be overcome?

In the following subsections, each of these issues is examined to highlight the major factors to be considered in resolving it.

Project Sponsorship

A decision must be made as to what entity should sponsor the project. For a joint project serving Colbert and Lauderdale Counties, possible sponsors include: a special solid waste management authority, created specifically for the project; the

two counties and major cities in the area, in a joint venture; and one of the counties or cities that is interested in assuming the lead role and to which responsibility can be delegated (e.g., the City of Muscle Shoals or Colbert County). For a project serving Colbert County alone, possible sponsors include Muscle Shoals, Colbert County directly, or a Colbert County Solid Waste Management/Resource Recovery Authority, which could be created for the project.

The creation of a special authority has certain advantages over sponsorship by an existing entity. In most states, a specially created solid waste management authority is not subject to competitive bid requirements of construction and, thus, can adopt the most appropriate procurement method, select the most qualified system vendor through negotiated bidding, and negotiate long-term contracts for solid waste delivery and system operation. The major limitation of sponsorship by a specially created entity is its lack of taxing authority, which limits financing options to IRBs or equity and IRBs.

Allocation of Project Risks

Unlike public works projects normally undertaken by local governments, resource recovery projects are risky, chiefly because:

- Recovery technology is not fully proven.
- Waste volumes and composition are variable.
- Operating experience is limited.
- Product user requirements are stringent.

These factors give rise to specific risks in four areas:

1. Project economics (e.g., lifetime operating and maintenance costs, lifetime product revenues, capital costs, lifetime net disposal costs).
2. Marketing (e.g., user requirements, user investments, product prices, contract duration).

3. System performance (e.g., product quality, recovery efficiency, processing capacity, reliability, residual disposal requirements).

4. Waste stream (e.g., volume changes, composition changes, payment of disposal fees).

The sponsoring entity must evaluate each area of risk and determine which participant in the project is best able to assume and manage a particular risk. For example, the project sponsor can deal with the risk that a minimum daily tonnage will fail to be delivered to the project. By contrast, the system vendor/operator can best deal with the risk that the system will not be able to process the amount of waste it was designed to handle.

In general, the system vendor can best deal with the economic and technical risks associated with the project's technology. The project sponsor will need to devise mechanisms to ensure that the system vendor assumes these risks. System vendors are often asked to provide contractual guarantees of system performance and economics (e.g., processing capacity, recovery efficiency, plant reliability and availability, product quality, O&M costs). In return, the vendor receives a service fee that compensates for the risks assumed.

Procurement Approach

There are three methods of procurement used for resource recovery projects:

- An architectural and engineering (A&E) contract, which is customary for facility design and equipment selection, preparation of competitive bid specifications, construction supervision, and, possibly, facility shakedown. Construction and equipment installation are competitively bid. Full-scale operation, and, possibly, shakedown are the responsibility of the public owner.

- A turnkey approach, in which a single entity performs the services that would otherwise be provided by an A&E, plus construction, testing, and shakedown of the system. Payment is made

to the turnkey contractor following successful shakedown and acceptance by the public sponsor. Full-scale operation is the responsibility of the public owner.

- A full-service approach, in which a single contractor performs all functions of a turnkey contractor and is responsible for full-scale operation of the facility (generally ranging from 5 to 20 years).

The following table summarizes the extent to which various risks can be transferred from the public sector to private industry under the three procurement approaches:

Key Project Risks	A&E	Turnkey	Full Service
Project economics	None	Limited	Substantial
Marketing	None	None	Substantial
System performance	Very Limited	Limited	Substantial
Waste stream	None	None	Limited

The full-service approach vests the maximum degree of control in the vendor and, thus, offers the greatest opportunity for transferring risks to the vendor. The sponsoring entity can transfer a maximum of risk to the full-service vendor/operator by obtaining contractual guarantees for the system's technical and economic performance.

Financing Method

Resource recovery projects in the United States have typically been financed with tax-exempt GOBs or IRBs, but, as a result of recent changes in tax laws, resource recovery system vendors, developers, financing entities, and industrial concerns (i.e., energy customers) are increasingly interested in assuming constructive ownership of a resource recovery facility. Constructive ownership affords substantial tax benefits (i.e., investment tax credits, depreciation tax shield). Internal Revenue Service (IRS) requirements for constructive ownership can be satisfied by making an equity

contribution to the project or by assuming responsibility for its total debt service obligations.

In making the preliminary determination of the feasibility of resource recovery projects for Colbert and Lauderdale Counties, economic feasibility was examined under three financing methods: 100-percent IRB, 25-percent equity and 75-percent IRBs, and 100-percent GOB. The choice of financing method has a major impact on the economic attractiveness of a given resource recovery project. However, in addition to economic impacts, each financing method offers several benefits that must be considered in selecting an appropriate financing method, as outlined in the following paragraphs.

IRB Financing. Tax-exempt IRBs are commonly used to finance resource recovery projects. Because project revenues (i.e., energy revenues and disposal fees) are the only sources of funds to retire IRBs, a rigorous analysis of project economics is required, to ensure that revenues will be sufficient. Hence, the effect of IRB financing is to ensure that any project implemented is fully justified on its economic merits. In addition, IRBs do not reflect on the debt capacity of the issuing entity, because the funds are borrowed on a project basis.

Equity/IRB Financing. Under this financing method, a partial equity contribution is made by a private investor (e.g., the energy customer, the system vendor, the project developer), and the balance of funding is obtained through IRBs. The equity contribution reduces the bond issue requirement and provides significant tax advantages to the private investor. Depending on the investor's tax bracket, the timing of the investment tax credit, and the depreciation period and method used, the net present value of the tax benefits resulting from a 25-percent equity contribution can represent an after-tax return on investment of 25 to 30 percent. However, to realize such a return, the equity contribution must be made by an entity that can utilize the tax benefits, i.e., a profitable concern with taxable income to shelter. In addition, the equity

contribution vests project ownership with the private investor and, for practical purposes, requires private operation of the facility.

GOB Financing. Like IRBs, tax-exempt GOBs are commonly used to finance resource recovery projects. In addition to project revenues, the full faith and credit of the sponsoring entity are pledged to retirement of GOBs, so taxing mechanisms may be used to meet obligations in the event that project revenues are insufficient. As a result, GOBs are less risky for bondholders than are IRBs, carry a lower interest rate and bond financing costs, and are easier to market. (Bond financing costs are typically less than 0.5 percent of total bond issue for GOBs, but may be as high as 3 percent for IRBs.) However, because of the full faith and credit pledge, GOBs can typically be used only for projects sponsored by entities having taxation authority. In addition, GOBs do reflect on the debt capacity of the issuer. Consequently, debt capacity ceilings may be reached, precluding subsequent debt issues for financing such projects as hospitals or schools.

System Design

For the purpose of this preliminary feasibility study, the scale and technology for each resource recovery alternative were selected to fit the estimated energy requirements and practices of the prospective energy customer. However, no attempt was made to optimize a given resource recovery system. Additional analysis must be performed to establish more specifically the scale and configuration of any resource recovery technology to be implemented.

The optimal scale for any given project will depend on the results of the analysis of waste generation, composition, and control (i.e., current waste generation, the supply of processible waste, and the amount of waste availability for delivery to a resource recovery project). In addition, the counties

need to consider the possible increase in solid waste generation, which depends on population growth in the period 1980-2000. After considering current and projected waste supply, the two counties will need to decide whether to build: a system that will be too large initially but will accommodate an increasing amount of waste; a system that will be too large initially, appropriately sized for the middle of its useful life, and too small in later years; or a system that will be appropriate for the waste supply in its initial years, with some allowance for future expansion as waste generation increases.

Legal and Institutional Barriers

There are numerous legal and institutional barriers to the implementation of a resource recovery project, primarily because few projects have been implemented. Institutional and legal barriers include site acquisition problems; traffic impacts on the surrounding neighborhoods and communities; the legality of negotiated procurements, long-term put-or-pay contracts with waste haulers, and take-or-pay contracts with energy users; and the prospect of mandatory participation of private haulers. All of these barriers must be overcome before project implementation.

APPENDIX

RESOURCE RECOVERY AS AN INDUSTRIAL DEVELOPMENT CATALYST

This section addresses the concept of utilizing resource recovery to attract new industry to the Lauderdale County area, and discusses obstacles associated with the concept of resource recovery as an industrial development catalyst.

A list of suitable customers for resource-recovered energy is given and capital cost estimates and resulting economics are developed for a possible Lauderdale County project, provided a suitable energy customer can be secured.

INDUSTRIAL DEVELOPMENT CONSIDERATIONS

As previously stated, a successful resource recovery project requires at a minimum: available waste, a viable energy market, an available site, a technology to process the waste and meet market requirements, and viable economics. While all of these factors must be assessed in tandem to reach a determination of project feasibility, without an attractive and technically feasible energy market, no project opportunities exist, even if the other necessary elements are there. As a consequence, while a community's intention to build a resource recovery facility (i.e., a local source of reliable and economic energy) may be attractive to an industry seeking to locate a new plant, a community cannot realistically make a decision to implement resource recovery until it is assured of a firm commitment from the energy customer to purchase waste-derived energy at a price that will afford sufficient revenues to the project such that project economics are viable.

A community that is committed to the concept of resource recovery, but is lacking a viable energy market, can work with its industrial development commission or similar entity to try to attract a potentially compatible industry to the area. An opportunity to obtain this alternative energy supply could be

an important catalyst in an industry's decision on where to locate. Any commitment to resource recovery must, however, be understood as contingent on: first, being able to meet an industry's energy requirements; and second, economic viability.

In building a resource recovery facility to service a new industry, scheduling considerations arise. For example, if from the point of deciding to go ahead with resource recovery, 3 years were required to reach the point of facility operations, whereas only 2 years were required to build the new industrial plant, construction of a new industrial plant could be delayed 1 year to make the schedules compatible, or the industry could build a temporary power plant for use until the recovery facility became operational and thereafter for standby purposes.

This approach to project development requires "good-faith" negotiations between the community and the prospective energy market as the host community cannot commit to a project until it can be satisfied that the project is both technically and economically feasible and environmentally sound.

The remainder of this discussion addresses the energy profile of desirable market candidates. Table is an exemplary list of types of industries whose energy requirements are typically compatible with resource recovery.

Overall Energy Demand

A desirable energy customer is able to use all of the energy that the resource recovery facility produces. If the energy buyer relies entirely on the resource recovery facility, the facility will have to include its own standby capability (typically oil- or gas-fired package boilers). The cost of this standby capacity will increase moderately the capital cost of the resource recovery facility. If the energy buyer's requirements exceed the output of the resource recovery, it will have to maintain in-house energy production units to meet

this excess, which could also be used when the recovery facility is down for scheduled maintenance or other reasons.

In order for a resource recovery facility to be economically viable, the energy customer must be able to purchase a minimum quantity of energy on a reasonably continuous basis. Experience with numerous resource recovery facilities indicates that the minimum energy consumption necessary to support a resource recovery facility is equivalent to approximately 25 million Btus* per hour on a three-shift basis (24 hours per day) at least 5 days per week (but preferably 7 days per week). Thus, the most desirable energy customer is one who has a constant energy demand, operates on a continuous basis, and has requirements that equal or exceed the output of the resource recovery facility.

Seasonal variability in process or heating steam demand can be accommodated by a cogeneration facility. Cogeneration (the addition of a turbine-generator to the system to produce electricity while extracting steam for sale) provides a means of operating at a constant output even when the steam user has a high seasonal variability.

Fuel Use Alternatives

The objective of selling energy derived from solid waste is to displace fuels used by the customer. In the case of a new industry, the resource recovery facility would have to offer this energy at a price lower than that which the customer would have to pay for alternative available fuels. Therefore, the most attractive industrial buyer would be one that otherwise would be using oil or gas.

Displacement of oil would likely provide the highest energy revenues to the project and the greatest energy savings

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* This figure represents approximately 17,000 lbs/hr of process grade steam.

to the customer. If the displaced oil is low-sulfur in content, the potential energy savings to the customer will likely be the greatest. Conversations with North Carolina State University personnel indicate that any new oil-fired power plant for a manufacturing concern would probaby have to use low-sulfur oil because of current air quality standards.

While natural gas is still less expensive than No. 6 oil, it is likely that by 1985, on an energy-parity basis, natural gas prices will be equivalent if not higher than those of No. 6 oil.

Coal is currently a substantially less expensive fuel and is readily available in the southwest. However, the capital and operating costs associated with a coal-fired power plant typically require that the industrial concern be raising at least 200,000 pounds of steam per hour before this approach can be economically justified. Currently, there are few resource recovery plants that can compete economically with a coal-fired plant, such that displacement of coal by waste-derived energy is unlikely.

Suitable Customers for Resource Recovered Steam

Table A.1, which follows, lists a number of generic industries found to have energy requirements compatible with the production of resource-recovered steam.

Potential Economics

Table A.2 presents the estimated financing requirements for a resource recovery facility sized to accommodate Lauderdale County's waste generation and provide low-pressure process steam to a new industry. Tables A.3 through A.5 present

projected 1985* and 1990 economics for this possible project under three financing methods.

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* 1985 was selected as the first year of commercial operations indicating that the identification and recruitment of a suitable energy customer would likely add at least 12 months to the implementation process.

TABLE A.1

EXAMPLES OF TYPICAL INDUSTRIES WITH ENERGY REQUIREMENTS COMPATIBLE WITH RESOURCE RECOVERY

Brick Manufacturing

Chemical Processing

- Asphalt Manufacture
- Petrochemical Refinery
- Pharamaceutical

Commercial Laundry

- Brewery
- Bottling Plant
- Candy Manufacture
- Distillery
- Frozen Food Manufacture
- Grain Processing
- Meat Packing/Processing

Leather

- Finishing Plant
- Tannery

Pulp and Paper

- Paperboard Manufacture
- Paper Converting
- Pulp Mill

Rubber

- Tire Manufacture
- Tire Recapping

Textile

- Textile Dryer
- Textile Finisher

Tobacco

- Tobacco Manufacture (cigarette, cigar)

Assorted Heavy Manufacturers

- Automobile Assembly
- Truck Assembly
- Farm Implements

TABLE A.2

FINANCING REQUIREMENTS FOR LAUDERDALE COUNTY

225 TPD MCS PRODUCING PROCESS STEAM

FOR NEW INDUSTRY*

COST ELEMENTS	FINANCING METHOD ($000s)		
	IRB	GO	25% EQUITY/IRB
A. Capital Cost	10,400	10,400	10,400
B. Engineering/Legal	400	400	400
Less: Equity Contribution	-	-	(2,700)
SUBTOTAL	10,800	10,800	8,100
C. Capitalized Interest	1,541	1,285	1,141
D. Allowance for Startup	350	350	350
E. Debt Service Reserve	2,149	-	1,624
F. Bond Financing	460	125	345
TOTAL BOND ISSUE	15,300	12,560	11,560
TOTAL FINANCING REQUIREMENTS	15,300	12,560	14,260

* Costs are projected to 1984 $ as 1984 would be the beginning of the design/construction phase; hence, the bond would be issued in 1984.

TABLE A.3

PROJECTED ECONOMICS FOR ALTERNATIVE #2

225 TPD MODULAR COMBUSTION SYSTEM

(IRB FINANCING)

ANNUAL SOLID WASTE THROUGHPUT (tons)	47,000
ANNUAL ENERGY SALES (pounds of steam)	211,680,000

EXPENSE ITEM ($/ton)	OPERATING YEAR	
	1 (1985)	6 (1990)
Debt Service	45.72	45.72
O&M	16.50	26.57
Residual Disposal	3.30	5.31
Operator's Fee	5.50	8.86
Transportation	-	-
SUBTOTAL	71.02	86.46
REVENUES ($/ton)		
Steam	35.64	57.38
Debt Service Reserve Earnings	6.40	6.50
SUBTOTAL	42.04	63.78
REQUIRED TIP FEE ($/ton)	28.98	22.68

TABLE A.4

PROJECTED ECONOMICS FOR ALTERNATIVE #2

225 TPD MODULAR COMBUSTION SYSTEM

(GO FINANCING)

ANNUAL SOLID WASTE THROUGHPUT (tons)	47,000
ANNUAL ENERGY SALES (pounds of steam)	211,680,000

EXPENSE ITEM ($/ton)	OPERATING YEAR	
	1 (1985)	6 (1990)
Debt Service	35.40	35.40
O&M	16.50	26.57
Residual Disposal	3.30	5.31
Operator's Fee	5.50	8.85
Transportation	-	-
SUBTOTAL	60.70	76.14
REVENUES ($/ton)		
Steam	35.64	57.38
Debt Service Reserve Earnings	-	-
SUBTOTAL	35.64	57.38
REQUIRED TIP FEE ($/ton)	25.06	18.76

TABLE A.5

PROJECTED ECONOMICS FOR ALTERNATIVE #2

225 TPD MODULAR COMBUSTION SYSTEM

(25% EQUITY/IRB FINANCING)

ANNUAL SOLID WASTE THROUGHPUT (tons)	47,000
ANNUAL ENERGY SALES (pounds of steam)	211,680,000

EXPENSE ITEM ($/ton)	OPERATING YEAR	
	1 (1985)	6 (1990)
Debt Service	34.55	34.55
O&M	16.50	26.57
Residual Disposal	3.30	5.31
Operator's Fee	5.50	8.86
Transportation	-	-
SUBTOTAL	59.85	75.29
REVENUES ($/ton)		
Steam	35.64	57.38
Debt Service Reserve Earnings	4.84	4.84
SUBTOTAL	40.48	62.22
REQUIRED TIP FEE ($/ton)	19.37	13.07